

- $f(x) = p^x q^{1-x}, x = 0, 1$

- $M_X(t) = pe^t + q$

- $E(X) = p$

- $V(X) = pq$

## 2. $\mathbf{X} \sim \text{Binomial}(n, p)$

- $f(x) = \binom{n}{x} p^x q^{n-x}, x = 0, 1, \dots, n$

- $M_X(t) = (pe^t + q)^n$

- $E(X) = np$

- $V(X) = npq$

## 3. $\mathbf{X} \sim \text{HYP}(n, M, N)$

- $f(x) = \frac{\binom{M}{x} \binom{N-M}{n-x}}{\binom{N}{n}},$

$$x = 0, 1, \dots, \min(n, M), n - x \leq N - M.$$

- $E(X) = \frac{nM}{N}$

- $V(X) = n \frac{M}{N} \left(1 - \frac{M}{N}\right) \frac{N-n}{N-1}$

- $f(x) = pq^{x-1}, x = 1, 2, 3, \dots$

- $F(x) = 1 - q^x, x = 1, 2, 3, \dots$

- $M_X(t) = \frac{pe^t}{1-qe^t}$

- $E(X) = \frac{1}{p}$

- $V(X) = \frac{q}{p^2}$

## 5. $\mathbf{X} \sim \text{Negative Binomial}(r, p)$

- $f(x) = \binom{x-1}{r-1} p^r q^{x-r}, x = r, r+1, \dots$

- $M_X(t) = \left(\frac{pe^t}{1-qe^t}\right)^r$

- $E(X) = \frac{r}{p}$

- $V(X) = \frac{rq}{p^2}$

## 6. $\mathbf{X} \sim \text{POI}(\mu)$

- $f(x) = \frac{e^{-\mu} \mu^x}{x!}, x = 0, 1, 2, \dots$

- $M_X(t) = e^{\mu(e^t-1)}$

- $E(X) = \mu$

- $V(X) = \mu$

## Common Distributions

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### 7. $\mathbf{X} \sim \text{DU}(N)$

- $f(x) = \frac{1}{N}, X = 1, 2, \dots, N$

- $M_X(t) = \frac{1}{N} \frac{e^t - e^{(N+1)t}}{1 - e^t}$

- $F(x) = \frac{x(1+x)}{2N}$

- $E(X) = \frac{N+1}{2}$

- $V(X) = \frac{N^2-1}{12}$

### 8. $\mathbf{X} \sim U(a, b)$

- $f(x) = \frac{1}{b-a}, a < x < b$  and zero otherwise

- $F(x) = \frac{x-a}{b-a}, a < x < b$

- $M_X(t) = \frac{e^{tb} - e^{ta}}{b-a}$

- $E(X) = \frac{a+b}{2}$

- $V(X) = \frac{(b-a)^2}{12}$

### 9. $\mathbf{X} \sim \text{Gamma}(\alpha, \theta)$

- $f(x) = \frac{1}{\theta^\alpha \Gamma(\alpha)} x^{\alpha-1} e^{-x/\theta}, x > 0$

- $F(x) = 1 - \sum_{i=0}^{\alpha-1} \frac{(x/\theta)^i}{i!} e^{-x/\theta}$

- $M_X(t) = \left(\frac{1}{1-\theta t}\right)^\alpha$

- $E(X) = \alpha\theta$

## Common Distributions

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- $V(X) = \alpha\theta^2$

### 10. $\mathbf{X} \sim \text{EXP}(\theta)$

- $f(x) = \frac{1}{\theta} e^{-x/\theta}, x > 0$  and zero otherwise.

- $F(x) = 1 - e^{-x/\theta}, x > 0$

- $M_X(t) = \left(\frac{1}{1-\theta t}\right)$

- $E(X) = \theta,$

- $V(X) = \theta^2$

### 11. $\mathbf{X} \sim \text{WEI}(\tau, \theta)$

- $f(x) = \frac{\tau}{\theta^\tau} x^{\tau-1} e^{-(x/\theta)^\tau}, x > 0$  and zero otherwise.

- $F(x) = 1 - e^{-(x/\theta)^\tau}$

- $E(X) = \theta \Gamma\left(1 + \frac{1}{\tau}\right)$

- $E(X^2) = \theta^2 \left[ \Gamma\left(1 + \frac{2}{\tau}\right) - \Gamma^2\left(1 + \frac{1}{\tau}\right) \right]$

### 12. $\mathbf{X} \sim \text{PAR}(\alpha, \theta)$

- $f(x) = \frac{\alpha \theta^\alpha}{(x+\theta)^{\alpha+1}}, x > 0$

- $F(x) = 1 - \left(\frac{\theta}{x+\theta}\right)^\alpha$

- $E(X) = \frac{\theta}{\alpha-1}$

- $V(X) = \frac{\theta^2}{(\alpha-1)^2(\alpha+2)}$
13.  $\mathbf{X} \sim \text{Beta}(a, b)$
- $f(x) = \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)} x^{a-1} (1-x)^{b-1}, 0 < x < 1$
  - $E(X) = \frac{a}{a+b}$
  - $V(X) = \frac{ab}{(a+b)^2(a+b+1)}$
14.  $\mathbf{X} \sim N(\mu, \sigma^2)$
- $f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-(x-\mu)^2/2\sigma^2}, x \in \mathbb{R}, \mu \in \mathbb{R}$   
and  $\sigma > 0$ .
  - $F(x) = \Phi\left(\frac{x-\mu}{\sigma}\right)$
  - $M_X(t) = e^{\mu t + \sigma^2 t^2/2}$
  - $E(X) = \mu$
  - $V(X) = \sigma^2$

- $f(x) = \frac{1}{x\sigma\sqrt{2\pi}} e^{-(\ln x - \mu)^2/2\sigma^2}, x > 0, \mu > 0$  and  $\sigma > 0$
  - $F(x) = \Phi\left(\frac{\ln x - \mu}{\sigma}\right)$
  - $E(X) = e^{\mu + \frac{\sigma^2}{2}}$
- $V(X) = e^{2\mu + \sigma^2}(e^{\sigma^2} - 1)$
16.  $\mathbf{X} \sim \text{CAU}(\theta, \eta)$
- $f(x) = \frac{1}{\theta\pi \left[1 + \left(\frac{x-\eta}{\theta}\right)^2\right]}$
  - $F(x) = \frac{1}{2} + \frac{1}{\pi} \tan^{-1}\left(\frac{x-\eta}{\theta}\right)$
17.  $\mathbf{X} \sim \text{EXP}(\eta, \theta)$
- $f(x) = \frac{1}{\theta} e^{-\frac{x-\eta}{\theta}} \quad x > \eta$
  - $F(x) = 1 - e^{-\frac{x-\eta}{\theta}}$
  - $M_X(t) = \frac{e^{\eta t}}{1 - \theta t}$
  - $E(X) = \eta + \theta$
  - $V(X) = \theta^2$

## Common Distributions

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18.  $\mathbf{X} \sim \text{DE}(\eta, \theta)$
- $f(x) = \frac{1}{2\theta} e^{-|x-\eta|/\theta} \quad -\infty < x < \infty$  and zero otherwise.
  - $F_X(x) = \begin{cases} \frac{1}{2} e^{(x+\eta)/\theta}, & x \leq \eta \\ \frac{1}{2} [1 - e^{-(x+\eta)/\theta}], & x > \eta \end{cases}$
  - $M_X(t) = \frac{e^{\eta t}}{1 - \theta^2 t^2}$
  - $E(X) = \eta$
  - $V(X) = 2\theta^2$
19.  $\mathbf{X} \sim \text{Single Parameter Pareto}(\alpha, \theta)$
- $f(x) = \frac{\alpha\theta^\alpha}{x^{\alpha+1}}, x > \theta$
  - $F(x) = 1 - \left(\frac{\theta}{x}\right)^\alpha$
  - $E(X) = \frac{\alpha\theta}{\alpha-1}$
  - $E(X^2) = \frac{\alpha\theta^2}{\alpha-2}$